Power Supply Monitor
and Control Board

Interface Specification
for DFE and SEQ Power Supplies

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Summary

This note describes how the Power Supply Monitor and Control Board appears to the 1553 network (remote interface) and the user via the LCD display (local interface).

The way that the Power Supply Monitor and Control Board appears to the outside world is primarily determined by the program running on the microcontroller. This specification was written for a microcontroller program designed for DFE and SEQUENCER power supplies on the center platform. Other applications may vary.

DFE and SEQ connections

DFE and SEQ subracks each require a Vicor PFC mini supply with two outputs, called primary and secondary. For SEQ supplies the primary output is rated for 5.0V @ 160A and the secondary output is rated for 5.2V @ 80A. For DFEs the primary output is 3.3V @ 160A and the secondary output is 5.0V @ 40A.

Each supply output requires two analog inputs on the Monitor/Control Board: one for the voltage and one for the current (an external shunt is used). There are four SEQ supplies and two DFE supplies in each chassis box (refer to engineering note 2001-01-30A). There is one Monitor/Control Board in each power supply chassis box.

The mapping between the Monitor/Control Board I/O and DFE and SEQ power supplies is as follows:
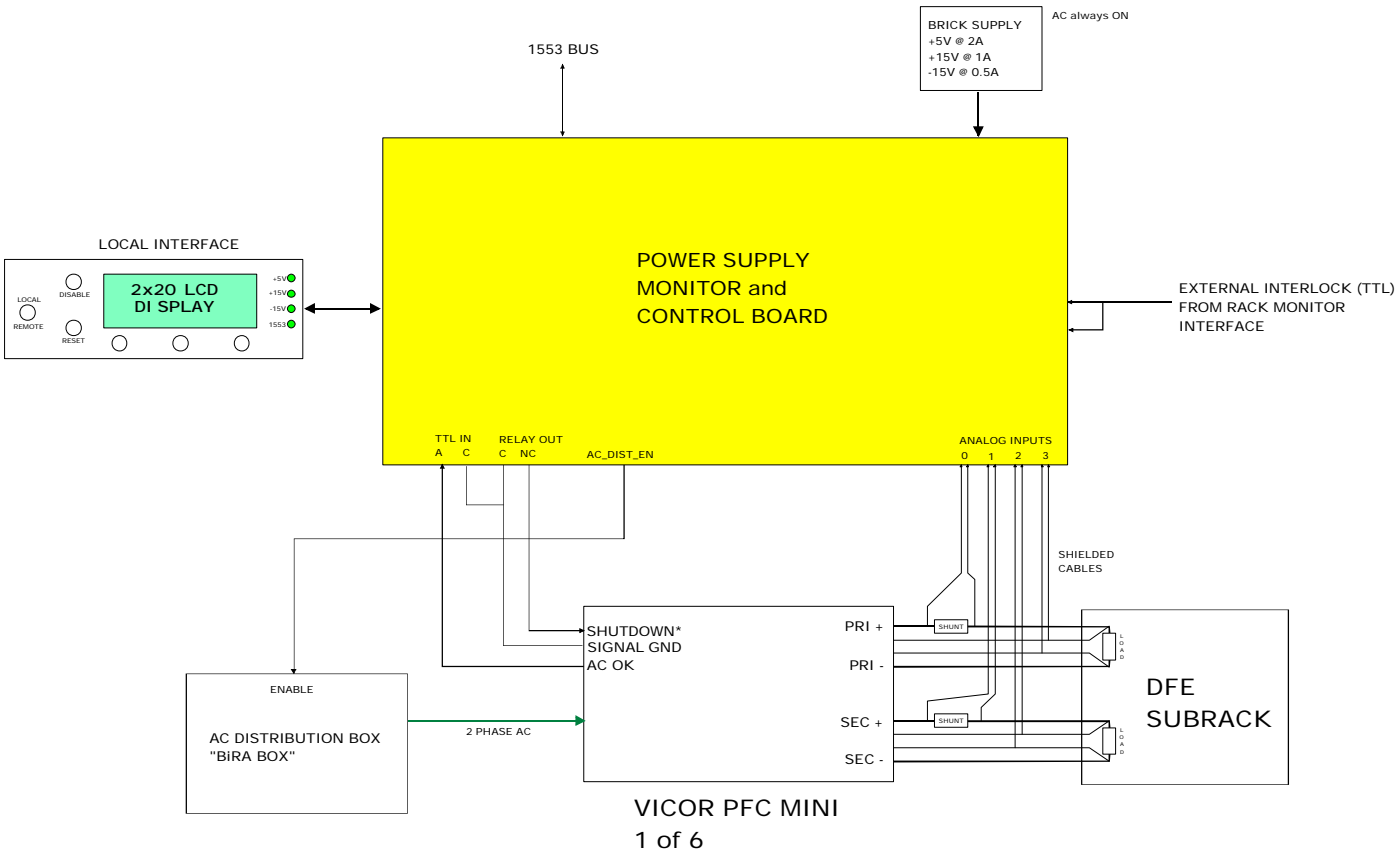
analog channel	function	supply	contact output	AC OK input
0	primary voltage	SEQ #1	0	0
1	primary current			
2	secondary voltage			
3	secondary current			
4	primary voltage	SEQ #2	1	1
5	primary current			
6	secondary voltage			
7	secondary current			
8	primary voltage	SEQ #3	2	2
9	primary current			
10	secondary voltage			
11	secondary current			
12	primary voltage	SEQ #4	3	3
13	primary current			
14	secondary voltage			
15	secondary current			
16	primary voltage	DFE #1	4	4
17	primary current			
18	secondary voltage			
19	secondary current			
20	primary voltage	DFE #2	5	5
21	primary current			
22	secondary voltage			
23	secondary current			

External Interlock Connections

The DFE and SEQ subracks are located in two different relay racks on the center platform. Each relay rack contains a Rack Monitor Interface (RMI) which monitors smoke, airflow, etc. The TTL interlock output from both of these RMIs should connect to the External Interlock Inputs on the Power Supply Monitor and Control Board. If either of the RMIs drop their Interlock Outputs the board will disable the AC Distribution box, killing the AC to all power supplies.

The AC Distribution Enable output on the Monitor/Control Board should connect to the Interlock Input on the "BiRA" AC Distribution box.

DFE/SEQ Connection Diagram

1553 BUS

BRICK SUPPLY
+5V @ 2A
+15V @ 1A
-15V @ 0.5A

AC always ON

LOCAL INTERFACE

LOCAL
REMOTE

DISABLE

RESET

2x20 LCD
DI SPLAY

+5V
+15V
-15V
1553

POWER SUPPLY
MONITOR and
CONTROL BOARD

EXTERNAL INTERLOCK (TTL)
FROM RACK MONITOR
INTERFACE

TTL IN
A   C

RELAY OUT
C   NC

AC_DIST_EN

ANALOG INPUTS
0   1   2   3

SHIELDED
CABLES

ENABLE

AC DISTRIBUTION BOX
"BiRA BOX"

2 PHASE AC

SHUTDOWN*
SIGNAL GND
AC OK

PRI +

PRI -

SEC +

SEC -

SHUNT

SHUNT

LOAD

LOAD

DFE
SUBRACK

VICOR PFC MINI
1 of 6

J0036.3

Trip Operation

When the real-time current or voltage measurement exceeds the corresponding trip threshold, the supply trips off. This means that the supply outputs are disabled by shorting the Global Shutdown pin to Signal GND. This does not turn off the AC power to the supply.

All power supplies connected to the Monitor/Control Board can trip off independently of each other. However, all trips are cleared at the same time.

On/Off Control

Supplies can be turned on and off independently. This is also done by enabling/disabling the outputs. Primary and secondary supply outputs function together – it is not possible to control them independently.

If a supply trips off, the value of the ON/OFF bit is ignored. After the trips are cleared the value of the ON/OFF bit will control the supply.

Remote Interface (1553)

The 1553 host can read the following status information:

- ?? External Interlock status.
- ?? Local or Remote status.
- ?? "AC OK" Status for each supply.
- ?? AC Distribution Box enable status.
- ?? Trip status for each supply output.
- ?? ON/OFF status for each supply
- ?? Real-time current for each supply output.
- ?? Real-time voltage for each supply output.
- ?? Voltage trip threshold for each supply output.
- ?? Current trip threshold for each supply output.
- ?? Board Temperature.

The 1553 host can control the following items:

- ?? Enable/Disable the AC Distribution box
- ?? Turn ON/OFF each supply independently.
- ?? Save all trip thresholds
- ?? Clear all trips.

1553 Memory Map

Status and Control Registers

ADDR	Description	Read/Write	Note
0000	Interlock and AC Distribution Enable status	R	1
0001	Board temperature status	R	2
0002	Supply Trip Status	R	3
0003	*reserved*		
0004	AC Distribution Control	RW	4
0005	Clear Trip Control	RW	5
0006	Save Thresholds Control	RW	6
0007	Sequencer #1 Control	RW	7
0008	Sequencer #2 Control	RW	7
0009	Sequencer #3 Control	RW	7
000A	Sequencer #4 Control	RW	7
000B	DFE #1 Control	RW	7
000C	DFE #2 Control	RW	7
000D	*reserved*		
000E	*reserved*		
000F	Sequencer #1 Status	R	8
0010	Sequencer #2 Status	R	8
0011	Sequencer #3 Status	R	8
0012	Sequencer #4 Status	R	8
0013	DFE #1 Status	R	8
0014	DFE #2 Status	R	8
0015	*reserved*		
0016	*reserved*		

Real-Time Voltage and Current Status Registers

ADDR	Description	Read/Write	Note
0017	Sequencer #1 Primary voltage	R	9
0018	Sequencer #1 Primary current	R	9
0019	Sequencer #1 Secondary voltage	R	9
001A	Sequencer #1 Secondary current	R	9
001B	Sequencer #2 Primary voltage	R	9
001C	Sequencer #2 Primary current	R	9
001D	Sequencer #2 Secondary voltage	R	9
001E	Sequencer #2 Secondary current	R	9
001F	Sequencer #3 Primary voltage	R	9
0020	Sequencer #3 Primary current	R	9
0021	Sequencer #3 Secondary voltage	R	9
0022	Sequencer #3 Secondary current	R	9
0023	Sequencer #4 Primary voltage	R	9
0024	Sequencer #4 Primary current	R	9
0025	Sequencer #4 Secondary voltage	R	9
0026	Sequencer #4 Secondary current	R	9
0027	DFE #1 Primary voltage	R	9
0028	DFE #1 Primary current	R	9
0029	DFE #1 Secondary voltage	R	9
002A	DFE #1 Secondary current	R	9
002B	DFE #2 Primary voltage	R	9
002C	DFE #2 Primary current	R	9
002D	DFE #2 Secondary voltage	R	9
002E	DFE #2 Secondary current	R	9

Voltage and Current Trip Threshold Registers

ADDR	Description	Read/Write	Note
002F	Sequencer #1 Primary Voltage Trip Theshold	RW	9
0030	Sequencer #1 Primary Current Trip Theshold	RW	9
0031	Sequencer #1 Secondary Voltage Trip Theshold	RW	9
0032	Sequencer #1 Secondary Current Trip Theshold	RW	9
0033	Sequencer #2 Primary Voltage Trip Theshold	RW	9
0034	Sequencer #2 Primary Current Trip Theshold	RW	9
0035	Sequencer #2 Secondary Voltage Trip Theshold	RW	9
0036	Sequencer #2 Secondary Current Trip Theshold	RW	9
0037	Sequencer #3 Primary Voltage Trip Theshold	RW	9
0038	Sequencer #3 Primary Current Trip Theshold	RW	9
0039	Sequencer #3 Secondary Voltage Trip Theshold	RW	9
003A	Sequencer #3 Secondary Current Trip Theshold	RW	9
003B	Sequencer #4 Primary Voltage Trip Theshold	RW	9
003C	Sequencer #4 Primary Current Trip Theshold	RW	9
003D	Sequencer #4 Secondary Voltage Trip Theshold	RW	9
003E	Sequencer #4 Secondary Current Trip Theshold	RW	9
003F	DFE #1 Primary Voltage Trip Theshold	RW	9
0040	DFE #1 Primary Current Trip Theshold	RW	9
0041	DFE #1 Secondary Voltage Trip Theshold	RW	9
0042	DFE #1 Secondary Current Trip Theshold	RW	9
0043	DFE #2 Primary Voltage Trip Theshold	RW	9
0044	DFE #2 Primary Current Trip Theshold	RW	9
0045	DFE #2 Secondary Voltage Trip Theshold	RW	9
0046	DFE #2 Secondary Current Trip Theshold	RW	9

Bit Definitions

Interlock and AC Distribution Status Register (note 1)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
													AC ON	EXT INT2	EXT INT1

Bit 0: Set if External Interlock #1 is OK.

Bit 1: Set if External Interlock #2 is OK.

Bit 2: This bit will be set when the AC Distribution Box is ENABLED. If this bit is set all supplies are getting AC power (unless the circuit breakers are off). If either External Interlock #1 or #2 is dropped the AC Distribution Box will be disabled and this bit cleared.

Board Temperature Status Register (note 2)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
								T7	T6	T5	T4	T3	T2	T1	T0

Bits 7..0   The board temperature in degrees C is reported as an unsigned integer.

Supply Trip Status (note 3)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
										D2	D1	S4	S3	S2	S1

D2: Set if DFE #2 has tripped off due to an OverVoltage or OverCurrent condition.

D2: Set if DFE #2 has tripped off due to an OverVoltage or OverCurrent condition.

S4: Set if Sequencer #4 has tripped off due to an OverVoltage or OverCurrent condition.

S3: Set if Sequencer #3 has tripped off due to an OverVoltage or OverCurrent condition.

S2: Set if Sequencer #2 has tripped off due to an OverVoltage or OverCurrent condition.

S1: Set if Sequencer #1 has tripped off due to an OverVoltage or OverCurrent condition.

If a bit in this register is set the corresponding power supply will have its primary and secondary outputs disabled. It's important to note that in this state the tripped off supply will still be getting AC power – the fans will continue to run, etc.

Trips cannot be cleared individually. To clear all of the tripped supplies, write to the **Clear Trip Control Register**.

This register tells the system which supplies have tripped off. It does not provide any additional information as to *why* the supply tripped off. To determine the exact cause of the trip, read the appropriate **Supply Status Register**.

AC Distribution Control Register (Note 4)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
															AC ON

If External Interlocks #1 and #2 are OK *AND* this bit is set, the Monitor/Control Board will enable the AC Distribution box. If the circuit breakers are all in the ON position then all supplies will get AC power and the "AC OK" bits in the Supply Status Words (see note 8) will bet set. The power up default value of this bit is zero.

Clear Trip Control Register (Note 5)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
															CT

Tripped supplies cannot be reset individually. To clear all of the tripped supplies, set the CT bit. The microcontroller will reset all of the tripped off supplies and then clear this bit automatically.

Once the trips are cleared, the supply outputs will be controlled by the value of the ON bit in the **Supply Control Register**.

Save Threshold Control Register (Note 6)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
															ST

Setting the ST bit causes the microcontroller to save all of the trip thresholds into non-volatile FLASH RAM. The trip thresholds in memory locations 0x002F-0x0046 will then become the power up defaults for the board.

Supply Control Register (Note 7)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
															ON

Set this bit to enable the Primary and Secondary outputs of the corresponding supply. If the supply has tripped off the value of bit will have no effect until the trip is cleared. The power default value of the ON bit is zero.

Supply Status Register (Note 8)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
				PRI OV	PRI OI	SEC OV	SEC OI							AC OK	ON

|	
PRI OV:	This bit is set if the supply has tripped off due to an OverVoltage condition on the Primary output.
PRI IO:	This bit is set if the supply has tripped off due to an OverCurrent condition on the Primary output.
SEC OV:	This bit is set if the supply has tripped off due to an OverVoltage condition on the Secondary output.
SEC IO:	This bit is set if the supply has tripped off due to an OverCurrent condition on the Secondary output.
AC OK:	This bit is set if the supply is getting AC power.
ON:	This bit is set if the supply outputs are enabled. If the supply is tripped off this bit will be cleared.

Real-Time Voltage and Current Registers; Trip Threshold Registers (Note 9)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Integer part								fractional part							
128	64	32	16	8	4	2	1	1/2	1/4	1/16	1/32				

Real time currents and voltages are reported using this unsigned fixed-point notation. Trip thresholds use this same notation as well. Units are Amps or Volts, depending on what memory location you're looking at. For example, if memory location 0x002C contains 0x6D70 that means that the current on DFE supply #2's Primary output is 109.34 Amps.

Local Interface
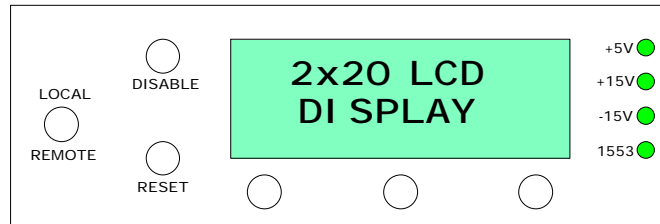
Local/Remote mode. If the Monitor/Control board is placed into Local Mode all Remote Interface control registers will be disabled. Remote Interface status registers will continue to be updated as usual.'

Disable Button. If in local mode, pressing the disable button clears all of the supply ON bits, disabling all supply outputs. If in Remote Mode this button has no effect.

Reset Button. Pressing reset momentarily causes the microcontroller to reset. Press and hold for more then 2 seconds to perform a hard reset of all logic on the control board. This button works in Local and Remote modes. The power up defaults are as follows:

> All trips cleared.
>
> AC Distribution Enabled
>
> All supply ON/OFF bits cleared – all supply outputs are disabled.
>
> Trip thresholds defaults are loaded from FLASH RAM.

LEDs. Three power supply indicator LEDs show that the small "brick" supply is working. The fourth LEDs lights whenever a 1553 Host is talking to this board.

LCD display and buttons. All of status and control information available to the Remote Interface can also be accessed through the LCD menus and menu buttons. Additionally, the user can set the 1553 RT address here. A basic menu outline is listed below.

1 Status Menu
    1.1 View real time currents and voltages for Primary and Secondary outputs on all supplies
    1.2 View ON/OFF status
    1.3 View "AC OK" status
    1.4 View interlock status
    1.5 View board temperature
    1.6 View the 1553 RT address.
2 ON/OFF Menu
    2.1 Enable/disable individual supplies
    2.2 Enable/disable AC Distribution Box
3 Trip Control Menu
    3.1 Clear all trips
    3.2 View or modify trip thresholds
    3.3 Save all trip thresholds
4 Setup Menu
    4.1 Set RT address